

## Vacuum Compatible Percussive Dynamic Cone Penetrometer, Phase I



Completed Technology Project (2009 - 2009)

## Project Introduction

Honeybee Robotics proposes to develop a vacuum compatible percussive dynamic cone penetrometer (PDCP), for establishing soil bin characteristics, with the ultimate intent of taking it to a flight system level. Penetrometers are used to determine the Cone index (CI), which is a composite index influenced by both soil compressibility and shear strength. A dynamic cone penetrometer is used to estimate bearing strength, soil compressibility, and shear strength (when compared with calibration data), consisting of a percussive actuator and a rod with a sharp 60 degree cone at the end. The penetrometer is driven into the soil under constant load and the penetration, converted to California Bearing Ratio (CBR), which gives an indication of soil trafficability. The Honeybee-developed percussive dynamic cone penetrometer offers the significant advantage of being a low mass, low power, low force, stand alone device that requires limited to no human intervention to operate, as opposed to heavy and cumbersome manual Dynamic Cone Penetrometer (DCP) widely used today. This percussive system is also of further advantage with its capability to reach much greater depths than typical surface tools such as Bevameter. The high-frequency vibration of the percussive rod also reduces the force required for pushing a rod into regolith by almost two orders of magnitude. This translates directly into smaller rover/lander or less effort on behalf of an Astronaut.

## Anticipated Benefits

Potential NASA Commercial Applications: Within the scope of a flight ready system is going to be the task of making this system not only vacuum compatible, but reliable, heat resistant, and capable of coping with lunar dust. It will also have to be compact and light weight. All of the scientific and technological advances obtained from this project will translate directly to development of a technically advanced, and robust terrestrial surveying tool ideal for commercial, scientific, and defense applications, where its portability and ease of use with minimum user input will be most valuable assets.



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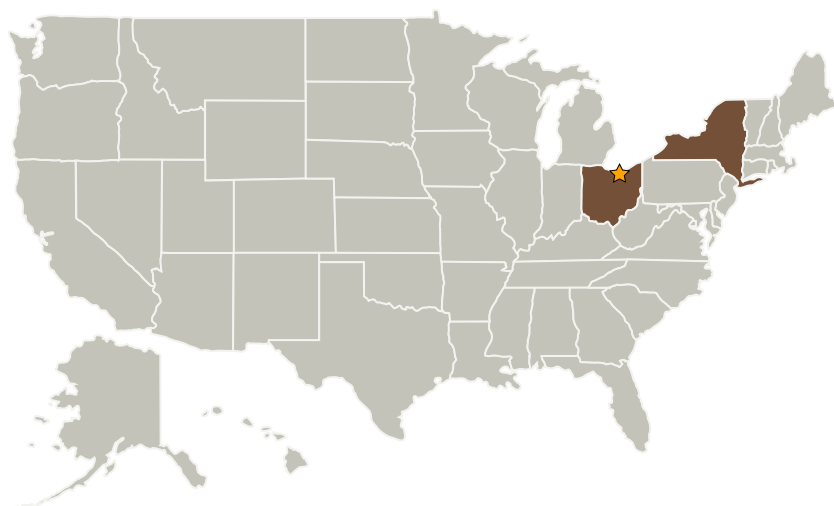
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## Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★ Glenn Research Center(GRC)	Lead Organization	NASA Center	Cleveland, Ohio
Honeybee Robotics, Ltd.	Supporting Organization	Industry	Pasadena, California

## Primary U.S. Work Locations

New York	Ohio
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## Project Transitions

**January 2009:** Project Start

**July 2009:** Closed out

**Closeout Summary:** Vacuum Compatible Percussive Dynamic Cone Penetrometer, Phase I Project Image

## Organizational Responsibility

**Responsible Mission Directorate:**

Space Technology Mission Directorate (STMD)

**Lead Center / Facility:**

Glenn Research Center (GRC)

**Responsible Program:**

Small Business Innovation Research/Small Business Tech Transfer

## Project Management

**Program Director:**

Jason L Kessler

**Program Manager:**

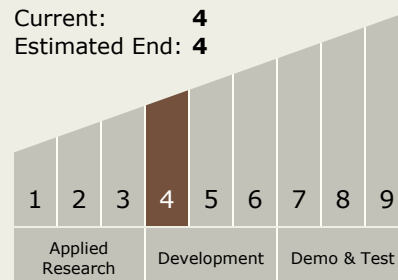
Carlos Torrez

**Principal Investigator:**

Kris Zacny

## Technology Maturity (TRL)

Start: **4**  
 Current: **4**  
 Estimated End: **4**



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## Technology Areas

### Primary:

- TX07 Exploration Destination Systems
  - └ TX07.1 In-Situ Resource Utilization
    - └ TX07.1.2 Resource Acquisition, Isolation, and Preparation